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Technique Article

A Novel Technique for Intra-aortic Balloon Positioning in the Intensive Care Unit

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Abstract: Proper positioning of the intra-aortic balloon catheter is very important as an improperly placed balloon can cause problems. A balloon placed too high can block off the arch vessels, whereas one placed too low can block the renal and splanchnic vessels. We propose a simple and reliable technique to properly position the intra-aortic balloon pump (IABP) catheter without the use of any sophisticated or expensive equipment in the intensive care unit if the catheter has migrated from the previously placed desired position. In this technique, we rely on the left radial arterial trace obliteration as the IABP catheter is pushed in along a guidewire as a marker for tip positioning.
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Postcardiotomy left ventricular failure is a well-known entity, which leads to failure to wean off bypass. The insertion of an intra-aortic balloon pump (IABP) catheter is known to help in this situation. Insertion of the IABP into the femoral artery remains the most popular approach for those patients in need of mechanical support after a cardiac operation. In the catheterization laboratory or in the hybrid operating room, the IABP insertion and positioning is guided by fluoroscopy. In the operating room, we have to rely on anatomical landmarks for the proper positioning of the IABP catheter and this later is confirmed by doing a chest x-ray (CXR) or by transesophageal echocardiography (TEE).

TECHNIQUE

An IABP catheter (RediGuard IAB; Arrow International, Everett, MA) was inserted into the descending aorta by the modified Seldinger approach through the common femoral artery in 27 cardiac surgical cases over a 12-month interval. The CXR in the intensive care unit (ICU) showed that the IABP tip was positioned distal to the desired location although we had inserted these after measuring the distance from the sternal angle to the umbilicus and from there to the femoral artery and confirmed by TEE in the operating room. This could be the result of the fact that we tend to position the patient's legs in a flexed and abducted position using pillows as shown in the Figure 1 for harvesting the vein. The IABP is also inserted in this position and it is fixed in the groin and once the pillow is removed at the end of the case, the IABP tends to move distally from point A to point B as shown in the schematic insert in Figure 1.

In the ICU, we perform the following procedure if we note that the IABP catheter has migrated from its desired position on the CXR:

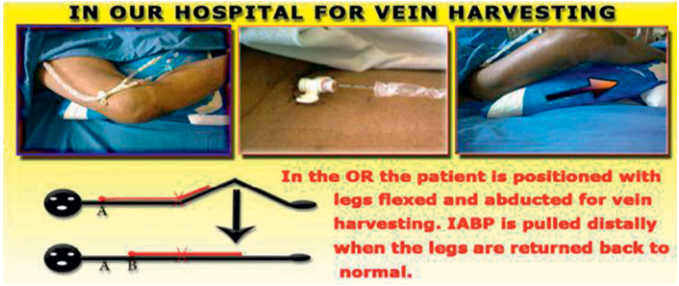

Figure 1. Positioning of lower limb for vein harvest and insertion and fixation of the intra-aortic ballooun pump.

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Figure 2. Intra-aortic balloon pump movement with corresponding left radial arterial (LRA) trace. (A–C) The IABP catheter is pushed proximally slowly in deflation noting the augmentation disappearing in the LRA trace as it occludes the left subclavian orifice (LSO). (D) No augmentation in LRA trace as the IABP catheter occludes the LSO. (E–F) The IABP catheter is slowly pulled out distally during deflation and augmentation trace reappears in LRA once it is beyond LSO. (G–H) The IABP catheter is pulled 1–2 cm distally beyond this achieving the goal of placement.

We insert a guidewire into the central lumen of the IABP catheter and reduce the balloon volume by 10–20%. The balloon augmentation is then reduced to 1:2 for heart rates below 100 beats/min and 1:4 for heart rates above 100 beats/min. The balloon movement along the guidewire is done only during the deflation phase of the IABP. We then monitor the balloon-mediated changes in left radial arterial (LRA) pressures on the patient monitor (Figure 2) to decide the optimal positioning. Once the balloon obliterates the LRA trace, we assume that the catheter tip is beyond the left subclavian orifice. Then the catheter is pulled back along the guidewire until the augmented LRA trace is obtained. Once the augmented trace is obtained, we pull back 1–2 cm to position the catheter optimally.

Balloon movement is advocated only along a guidewire to avoid the tip of the balloon causing an iatrogenic dissection. Movement during inflation of the catheter can cause coiling of the distal portion of the IABP without any appreciable forward movement of the tip and so the balloon catheter is moved only during deflation. Balloon volume is reduced to avoid the balloon hugging the aortic wall and impeding movement. Postprocedure we have checked the position of the IABP catheter by CXR and by TEE and in all these cases, the IABP tip was found to be properly positioned. Also, we have seen an improvement in the hemodynamics once the balloon is in the optimal position.

Moreover, the finding of IABP catheter migration has also led to a practice change in our hospital to remove the pillows from underneath the legs once the vein harvesting is over. In conclusion, from our experience so far, this technique has shown us that we do not require fluoroscopy or TEE for proper positioning of the IABP catheter once we are in the ICU or for that matter in the operating room. All that we require is a left radial arterial line.

DISCUSSION

The appropriate performance of the IABP is dependent on proper position (1,2). Ideally, the tip of the balloon should be positioned 2–3 cm distal to the origin of the left subclavian artery (LSCA) (1,3). This position results in maximum augmentation of coronary artery flow although minimizing the risk of embolization to the cerebral vessels and occlusion of the LSCA (3). The aortic knob is thought to be the radiographic landmark of choice for proper positioning (3,4). The recommended position for the tip of the balloon is just distal to the aortic knob. The aortic knob is a broad shadow on the CXR and hence erroneous placement of IABP can occur using it as a landmark. The carina was used as a radiographic landmark for positioning the IABP citing the fact that contrary to the aortic knob, the carina is a well-definable anatomic landmark on CXR. Also, the position of the carina relative to the aortic arch varies little when compared with the position of the aortic knob (5). Inward migration of the intra-arterial balloon catheter creates the potential for occlusion of the subclavian or the carotid artery resulting in unequal or absent radial pulses and dampening or loss of the arterial waveform in the radial artery (6). If an indwelling left radial arterial catheter is functioning at the time of insertion, a reasonable estimate of position may be made by watching balloon-mediated alteration of the arterial pulse waveform (7). The technique we describe offers the possibility of optimally positioning the IABP catheter

in a simple and reliable manner by just monitoring the LRA trace.

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